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(54) **Drier**

(57) A drier (3) intended for drying printing ink (2) applied to a material (1) by a printing machine, has a conveyor device (4, 5) which supports the material as it passes through the drier and at least two lamps (6, 6a) which emit ultra-violet (UV) radiation for the purpose of drying and/or hardening the printing ink. The two lamps (6, 6a) are located at such a distance (7) from each other that a material (1) which has passed beneath the first lamp (6), where it has been exposed on the one hand to UV radiation for the purpose of hardening the printing ink and on the other hand to the heat emitted by the lamp which emits UV radiation, will be able to pass through a section (7) which will cause the temperature of the material to fall before the material (1) passes beneath the second lamp (6a).

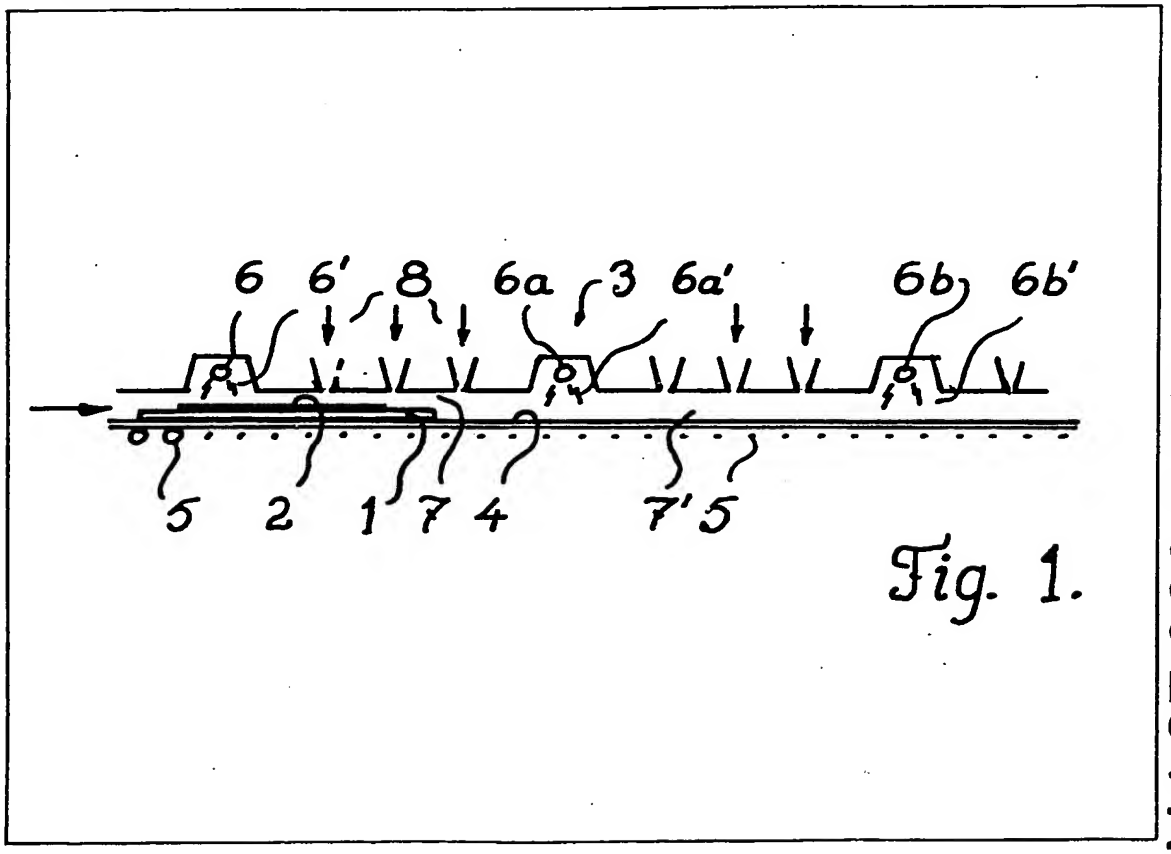

Fig. 1.

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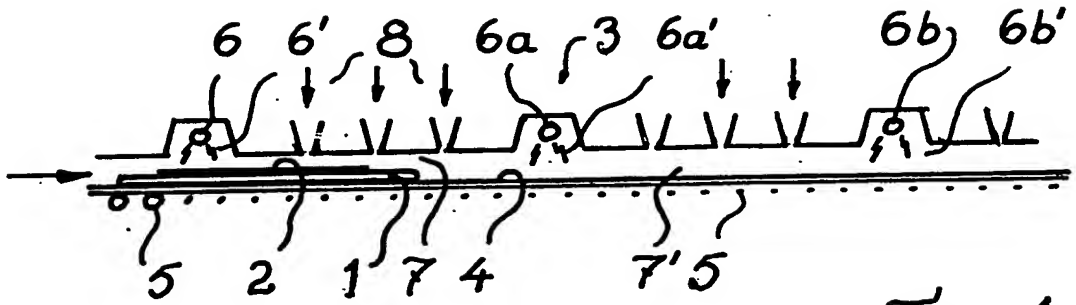

Fig. 1.

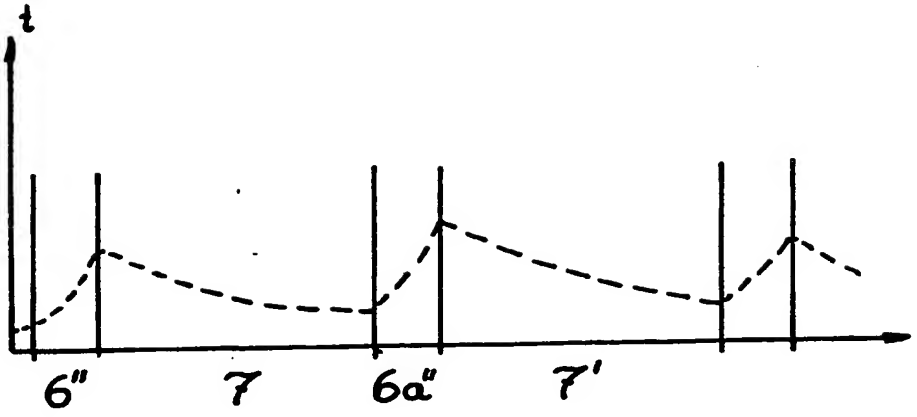

Fig. 2.

SPECIFICATION
Drier

The present invention relates to a drier, and above all to a drier of a type which is intended for drying printing ink applied to a material by a printing machine, for example a silk screen printing machine. The drier incorporates a conveyor device consisting of a means of supporting the material as it passes through the drier and at least two organs which emit ultra-violet (UV) radiation for the purpose of drying and/or hardening the printing ink.

The aim of the invention is also to provide details of a drier which is capable not only of drying printing ink which may be hardened by UV radiation, but also of drying solvent-based printing inks.

Various types of drier attached to printing machines have already been disclosed, by means of which it is possible to dry the printing ink which is applied to a material by the printing machine.

The drying process and the drying methods which may be involved are determined by the chemical composition of the ink and of the printed material.

Thus the possibility has already been disclosed of producing catalytic hardening or polymerisation of the printing ink when said ink has characteristics such that it is able to harden with the aid of organs which emit ultra-violet radiation.

The possibility has also been disclosed in the case of solvent-based printing inks of permitting the drying process to take place by evaporation or vaporization, i.e. by physical drying.

It has also been disclosed previously that physical drying, which takes place by the evaporation or vaporization of solvents which are present in the printing ink, may be made to proceed more rapidly by increasing the quantity of air which is blown and the supply of heat.

Also previously disclosed are printing inks of such a kind that hardening of the printing ink will take place with the aid of ultra-violet radiation by the process known as radiation hardening, in which the radiation activates a catalyst in the printing ink, thereby causing polymerisation (a linking together of molecules) of the layer of ink.

The most common types of screen printing inks dry by evaporation or by hardening or by a combination of both.

Special problems are encountered with the drier used with a silk screen printing machine, since the layer of printing ink which is applied may often be quite thick.

Several different kinds of drier have in fact already been disclosed which make use of organs which emit ultra-violet radiation, said ultra-violet radiation hardening the printing ink which is usually applied to glass, sheet metal and printed circuit boards. A drier which makes use of UV radiation is very simple, since one or more organs which emit UV radiation are installed above the conveyor, usually in the form of a gas discharge tube which emits very intense UV radiation and which will cause the printing ink to harden in a matter of seconds.

However, driers which make use of organs which emit ultra-violet radiation do suffer from the disadvantage that, although the actual hardening process as such may take place at ambient temperature, the mercury lamps which are currently available are designed in such a way that they will emit UV radiation only after having reached a high operating temperature. It is not unusual for the lamp to be required to reach a temperature of between 600 and 700°C. It will be appreciated that a considerable amount of heat output will thus be lost and is not required for the purpose of hardening the printing ink.

One additional practical consequence is that a drier which uses UV radiation must, as a rule, have two or more lamps positioned adjacent to each other in order to produce radiation of sufficient intensity to thoroughly harden the relatively thick layers of ink.

It will also be appreciated that the heat emission referred to above is of only marginal significance to the hardening of printing ink on glass or sheet metal and that the thermal radiation speeds up the hardening process to a certain extent, but that where hardenable printing inks are applied to temperature-sensitive materials such as paper and plastic the result will usually be contraction and in certain cases deformation of the material.

The aim of the present invention is to provide details of a drier of such a kind that when printing ink is applied to a material which is temperature-sensitive hardening may still take place in the drier without major contraction of the material occurring.

It has also been disclosed previously that a drier which is specially designed to harden and dry printing ink with the help of UV radiation may only be used for hardening that particular ink, and that this limitation is not always desirable in mixed production where solvent-based printing inks may also be used.

It is therefore particularly desirable to design a drier of such a nature that it is not only capable of hardening printing ink by means of UV radiation, but is also suitable for drying solvent-based printing inks.

The present invention describes a drier, intended above all for drying printing ink applied to a material by a printing machine, especially a silk screen printing machine, said drier incorporating a conveyor device consisting of a means of supporting the material as it passes through the drier and at least two organs which emit UV radiation for the purpose of drying and/or hardening the printing ink.

What may be regarded as being characteristic of the present drier is the fact that two organs which emit UV radiation are located at such a distance from each other that the material which passes beneath the first organ, where it has been exposed on the one hand to UV radiation for the purpose of hardening the printing ink and on the

other hand to the heat emitted by the organ which emits UV radiation, will be able to pass through a section which will cause the temperature of the material to fall before the material is allowed to pass beneath the second organ.

This arrangement thus enables the section between the organs to be used for treating the material with air, preferably chilled air, thereby eliminating the disadvantage described previously.

Where a number of organs which emit UV radiation, being more than two in number, are used in the drier, it is recommended that the space between each organ and the next should be used for treating the material with chilled air.

Nevertheless, there is nothing to prevent a group of organs which emit UV radiation, usually two in number, from being positioned adjacent to each other, and arranging the air treatment section between adjacent groups.

The present invention also describes a possibility of using the drier for solvent-based printing inks, when the organs which emit ultra-violet radiation may be disconnected and ordinary air or heated air used for drying the solvent-based printing ink in the section between the organs.

It may also be appropriate for the organs which emit UV radiation to be left connected during the drying of solvent-based printing inks, thus enabling use to be made of the waste heat produced by the organ which emits UV radiation.

It may also be appropriate for the power source to which the organs which emit UV radiation are connected to be disconnected, said power source being used for heating the air used for drying the solvent-based printing inks.

The attached drawing illustrates the significant characteristics of a proposed embodiment of the present invention, in which

Fig. 1 shows a side view and sectional view of part of a drier from which the principle of the present invention may be appreciated;

Fig. 2 shows the temperature variations within the material as it passes through the drier.

Referring to Fig. 1, a drier 3 is intended above all for drying printing ink applied to a material by a printing machine, preferably a silk screen printing machine designed to apply printing ink to the material.

It is evident that the drier requires a power supply, air fans, heating devices and such like, but, for clarity, these components are omitted from Fig. 1. The drier 3 receives material 1 printed with a layer of printing ink 2 from the printing machine (not shown in Fig. 1). The drier 3 incorporates a conveyor device 4 in the form of a belt resting on a number of rollers 5 and the conveyor belt 4 together with the rollers 5 thus constitute a means of supporting the material 1 as it passes through the drier. This embodiment also contains at least two, and in the case of the preferred embodiment three organs 6, 6a and 6b which emit UV radiation for the purpose of drying and/or hardening the printing ink, although their number is not critical to the function of the invention.

What is characteristic of the present invention is the fact that two organs 6, 6a which emit UV radiation are located at such a distance from each other that a material 1 which passes beneath the first organ 6, where it is exposed on the one hand to UV radiation 6' for the purpose of hardening the printing ink 2 and on the other hand to the heat emitted by an organ 6 which emits UV radiation, will be able to pass through a section 7 which will cause the temperature of the material 1 and of the layer of ink 2 which has been applied to it to fall before the material moves over to the second organ 6a, where it is exposed to UV radiation 6a' for the purpose of further hardening of the printing ink on the one hand, and on the other hand is exposed to the heat emitted by the organ 6a which emits UV radiation.

The section 7 between the organs 6 and 6a is designed in such a way as to enable the material 1 to be treated with air, preferably chilled air. It is also recommended that the air be allowed to pass through nozzles 8.

Although the preferred embodiment shows single organs 6, 6a and 6b which emit UV radiation, there is nothing to prevent these organs from being replaced by a group, usually two in number, of organs which emit UV radiation in such a way that a section 7 will then lie between adjacent groups.

Whether a group shall contain one or more organs is determined by the speed at which the material 1 passes through the drier, as well as by the nature of the material, the thickness of the printing ink and the facilities for cooling provided in the section 7.

Fig. 2 shows the temperature curve "T" for the material 1 as it passes through the drier illustrated in Fig. 1. There is a rise in temperature in the section 6" due to the heat, infra-red heat, produced by the organ which emits UV radiation, but as soon as the material 1 passes into the section 7, said material is acted upon by the air flowing through the nozzles 8, causing the material to cool, and as soon as the material enters the section 6a" there is a corresponding rise in temperature. The section 7' produces a further fall in temperature, and so on.

Although Fig. 2 shows the temperatures at the end of sections 6" and 6a" to be essentially identical, it should nevertheless be borne in mind that a certain rise in temperature is permissible.

The present invention also relates to a drier in which the material 1 to which a solvent-based printing ink 2 has been applied is subjected to drying in said drier, which may be done either by disconnecting the organs 6, 6a, 6b which emit UV radiation and exposing the printing ink 2 to treatment with air passing through the nozzles 8 in the section 7.

Or, in view of the high heat loss from the organs 6, 6a and 6b, it may be appropriate to leave said organs connected so that the infra-red radiation emitted by the organs will remove the solvent from the printing ink 2.

In many cases, however, it may be found more advantageous to disconnect said organs 6, 6a, 6b

and to connect their electrical power supply instead to a heating element not shown in the Figure for the purpose of heating the air passing through the nozzles 8.

It may be appreciated in each case that a drier in accordance with the present invention which has been designed principally to provide effective hardening of a printing ink by means of organs which emit UV radiation may also be used for drying solvent-based printing inks by a process of evaporation.

The invention is not, of course, restricted to the typical embodiment described above, but may undergo modifications within the scope of the following Patent Claims.

A drier in accordance with the present invention will be found to be particularly advantageous if the printing ink which has been applied to the material is in the form of a mixture of printing inks which on the one hand require the use of organs which emit UV radiation in order for them to harden, and which on the other hand require the use of vaporization and treatment with air in order to dry the solvent-based printing inks.

The distance between the organs 6, 6a may, of course, be varied in accordance with the speed of the conveyor, the thickness of the ink, and the intensity of the organ which emits UV radiation, etc., although in practice this distance should be between 0.5 and 1.5 metres.

CLAIMS.

1. A drier, intended principally for drying printing ink applied to a material by a printing machine, incorporating a conveyor device consisting of a means of supporting the material as it passes through the drier and at least two organs which emit ultra-violet (UV) radiation for the purpose of drying and/or hardening the printing ink, wherein two organs which emit UV radiation are located at such a distance from each other that a material which has passed beneath the first organ, where it has been exposed on the one hand to UV radiation for the purpose of hardening the printing ink and on the other hand to the heat emitted by the organ which emits UV radiation, will be able to pass through a section which will cause the temperature of the material to fall before the material passes beneath the second organ.

2. A drier in accordance with claim 1, wherein the section between the organs is designed so as to treat the material with air, preferably chilled air.

3. A drier in accordance with claim 1 or claim 2, wherein several organs which emit UV radiation are positioned in such a way that there is a certain distance betwen each.

4. A drier in accordance with claim 1 or claim 2, wherein a group, usually two in number, of organs which emit UV radiation are located adjacent to each other and separated by a certain distance form other adjacent groups.

5. A drier, intended principally for drying material to which printing ink has been applied and which has been discharged from a printing machine, incorporating a conveyor device consisting of a means of supporting the material as it passes through the drier, and at least two organs which emit ultra-violet (UV) radiation for the purpose of drying the printing ink, in which two organs which emit UV radiation are positioned at a certain distance from each other, thereby forming a section within which the material can be treated with hot air for the purpose of drying the solvent-based printing inks.

6. A drier in accordance with claim 5, wherein organs which emit UV radiation for the purpose of hardening the printing ink are also utilized in connection with the drying of solvent-based printing inks so as to benefit from the waste heat from the organ which emits UV radiation.

7. A drier in accordance with claim 5, wherein the organs which emit UV radiation for the purpose of drying the printing ink can be disconnected and air which has been heated can be used for drying the solvent-based printing inks.

8. A drier in accordance with any one of the preceding claims, wherein the distance between the or at least one pair of spaced apart UV sources is from 0.5 to 1.5 metres.

9. A drier for hardening and for drying printing ink, which drier includes a conveyor for conveying a printed material through the drier past at least two sources of UV light, which said sources are spaced apart from one another, and means for providing a current of fluid over the printing material as the material passes between the said spaced-apart UV sources.

10. A drier in accordance with claim 9, which additionally includes means for selectively providing a coolant or a heating said current of fluid.

11. A drier in accordance with any one of the preceding claims substantially as herein described with reference to the accompanying drawings.

New claims or amendments to claims filed on 12 July 1982

Superseded claims 1—11

New or amended claims:—

1. A drier for hardening and/or drying printing ink on a printed sheet material, which drier includes a generally horizontal conveyor for conveying a printed sheet material resting thereon through the drier, at least two UV light sources, which said sources are spaced apart from one another and disposed above the printed sheet material so as to provide spaced apart exposure regions in which the printed sheet material is exposed to UV light as it passes through the conveyor and, between the or each of successive spaced apart exposure regions a non-exposure region in which the printed material is essentially free from direct exposure to UV light, and means for directing a current of fluid at the printed material as it passes through the or each said non-exposure region.

2. A drier according to claim 1, which additionally includes means for selectively

providing a coolant or a hot said current of fluid.

3. A drier according to claim 1, which includes means for providing a current of coolant fluid to be directed by the said directing means at the said printed sheet material as it passes through the or each said non-exposure region so that, as the material passes through each exposure region it is, on the one hand, exposed to UV radiation for the purpose of hardening the printing ink and, on the other hand, subjected to heat emitted by the UV light source and, as the material passes through the or each non-exposure region it is subjected to cooling to provide a fall in temperature of the material.

4. A drier according to claim 1, which includes means for providing a current of hot fluid to be directed by the said directing means at the said printed sheet material as it passes through the or each non-exposure region.

5. A drier according to any one of the preceding claims, wherein the distance between the or at least one pair of spaced apart UV light sources is from 0.5 to 1.5 metres.

6. A drier according to any one of the preceding claims, which includes several said spaced apart UV light sources.

7. A drier according to any one of the preceding claims, wherein each UV light source is provided by a group of at least two UV lamps, the UV lamps of each group being located adjacent one another, but each said group being spaced apart from one another.

8. A drier according to any one of the preceding claims, substantially as herein described with reference to the accompanying drawings.

9. A method of hardening and/or drying printing ink on a printed sheet material, which method includes conveying the said material on a conveyor through at least two exposure regions of a drier, which exposure regions are provided by respective sources of UV light, which said sources are spaced apart from one another and disposed above the said material, and through a non-exposure region between the or each of successive spaced apart exposure regions, the said material being, in the or each said non-exposure region, essentially free from direct exposure to UV light, and directing a current of fluid at the said material as it passes through the or each non-exposure region.

10. A method according to claim 9, wherein the said fluid is coolant fluid and the temperature of the material is thereby caused to fall when passing through the or each non-exposure region.

11. A method according to claim 9, wherein the said fluid is hot fluid capable of drying solvent-based printing inks.

12. A method according to any one of claims 9 to 11 substantially as herein described with reference to the accompanying drawing.

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